T15D13 – Spontaneity IB Review MS

1. D

[1]

2. B

[1]

3. D

[1]

4. C

[1]

5. a reaction is spontaneous when $\Delta G^{\ominus}$ is negative;

at high T, $\Delta G^{\ominus}$ is negative;

$-T\Delta S^{\ominus}$ is larger/greater than $\Delta H^{\ominus}$;

at low T, $\Delta G^{\ominus}$ is positive because $-T\Delta S^{\ominus}$ is smaller than $\Delta H^{\ominus}$/*OWTTE*; 4

[4]

6. ($\Delta G^{\ominus} = \Delta H - T\Delta S^{\ominus}$)

as *T* increases, $-T\Delta S^{\ominus}$ becomes larger/more positive;
ΔG increases/becomes more positive/less negative;
process becomes less spontaneous/reverse reaction favoured; 3

[3]

7. (a) $C_6H_5OH + 7O_2 \rightarrow 6CO_2 + 3H_2O$; 1

Ignore state symbols.

(b) $\Delta H_r^{\ominus} = \Sigma \Delta H_f^{\ominus}$ products $- \Sigma \Delta H_f^{\ominus}$ reactants;

$-3050 = (6(-394) + 3(-286) - (\Delta H_f^{\ominus}$ phenol + O));

$\Delta H_f^{\ominus}$ phenol $= -172$ kJ mol^{-1}; 3

*Award **[3]** for correct final answer.*
Apply –1 (U) if appropriate.
*Award **[2 max]** for $\Delta H_f^{\ominus}$ phenol = +172 kJ mol^{-1}.*

(c) appropriate conversion of units;
$\Delta G = -172 - 298(-0.385)$

$= -57.3$ kJ mol^{-1}/$-57\,300$ J mol^{-1}; 3

*Award **[3]** for correct final answer.*
Accept answers in range –57.0 to –57.3 kJ mol^{-1}.
Accept 3 sig. fig. only.
Allow ECF from (b).
Apply –1 (U) if appropriate.

(d) spontaneous;
since ΔG is negative;
Allow ECF from (c). 2

(e) reaction becomes less spontaneous;
ΔG becomes less negative/more positive;
Accept a suitable calculation.
Allow ECF from (c). 2

[11]